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ELECTRO-CHEMISTRY,

WITH

POSITIVE RESULTS;

AND

NOTES FOR INQUIRY

ON THE SCIENCES OF

GEOLOGY AND ASTRONOMY;

WITH A

TRACT OF MISCELLANIES.

BY

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ADVERTISEMENT.

THESE Tracts, with the exception of the Tract of Miscellanies, I lately circulated with a view to inquiry. Since then I have, in the course of my experiments, obtained *positive results*, which go to establish my views on Electro-Chemistry. With some additions to these Tracts, I now submit them to the public—presenting them, as formerly, mainly as notes for further inquiry.

MERCHISTON CASTLE BANK,
JANUARY 28, 1858.

by heat,—I therefore inferred, that were two bodies, the one united with positive and the other with negative electricity, subjected to an intense heat, the two electricities, viewed as material elements, would have their affinities for the bodies with which they were in combination so loosened or impaired, that they would unite when connected with each other by means of a platinum wire, or any other conductor of electricity. With this view I employed a cast iron tray, twelve inches in length, ten in width, and three in depth. I covered the bottom of

FIG. 1.

the tray with a mixture of plaster of Paris and finely-sifted coal-ash, and upon the surface of this mixture I placed two thick glass tubes, hermetically sealed, the one containing a portion of the chlorate of potassa, and another an equivalent quantity of potassium. These tubes were connected internally

with each other by means of platina wires, one of which was introduced into the chlorate of potassa in the one tube, and the other into the potassium in the other. The position of the tubes in the tray are represented *Fig.* 1. I now filled the tray with plaster of Paris and coal-ash, and upon this mixture I placed an iron plate, on which were laid two weights, forty pounds each. The tray with the weights was placed on a common fire, the fireplace of which was so constructed, that an intense heat might at any time be produced. As oxygen would come off from the chlorate of potassa, when the temperature of that salt was raised, I inferred that the intense heat to which the oxygen and potassium would be subjected, would disunite positive electricity from the oxygen, and negative electricity from the potassium; and that the two electricities thus set free would escape by the platina wires, and unite with each other, heat being the product. After the tray which had been brought to a red heat had cooled down sufficiently, I proceeded to examine its contents. Both tubes were entire. I opened at one extremity the tube which contained the potassium, a portion of which fell out, and presented very much the external characters of carbon. Its metallic lustre was gone; and when thrown upon water, there was

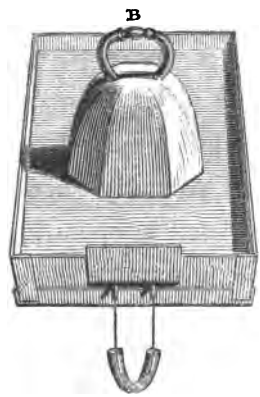
neither combustion nor action of any kind. I introduced a sharp-pointed wire into the tube, with a view of extracting what remained of the potassium; but the instant that I touched the potassium with the wire, the whole exploded in my hand. How is it that the properties and external characters of this substance were so very different from the properties and external characters of potassium? Is it that potassium, deprived of its negative electricity, possesses properties and external characters, such as I have described? I now examined the contents of the other tube. It was evident that oxygen had been disengaged from the chlorate of potassa, and that the residual constituents were those of the chloride of potassium. The only other change which had taken place was, that the surface of the tube appeared to be bedewed with moisture.

5. This first experiment was an earnest of what I might realise when provided with a suitable apparatus, and with those tubes which resist an intense heat, without fusion and without fracture. In the prosecution of my experiments, I found that flint glass tubes were not suitable, as they contained lead in their composition, which renders them easily fusible, and the materials which I introduced into them were generally blown out, or a rupture of the

tubes took place. From some difficulty, which I could not explain, I failed to obtain, though every effort was made on my part, those tubes which contain no lead in their composition, and which resist fusibility while exposed to an intense heat. Having, however, partially succeeded in my first experiment, I persisted in operating with such tubes as I could procure, unsuitable though they were, resolved either to verify my views on electro-chemistry, or prove them fallacious; and it was not until after years of toil and failure, I at last obtained a positive result, which proves that there is a latent electricity existing in bodies as well as a latent heat.

6. At the close of 1856, I procured *one* of those German glass tubes that contain no lead in their composition, and into which I poured a small portion of nitric acid; but as another tube was required, I substituted a tube of iron, into which I introduced a few grains of caustic potash. Both tubes were hermetically sealed, and contained platina wires which were not joined together externally as is represented in *Fig.* 1., but were kept apart from each other, and made to project beyond the tray, through two small perforations in one of its sides, as is represented in *Fig.* 2.

FIG. 2.



The iron tube deposited in the tray was insulated by inclosing it in a tube of glass, while the platina wires which passed through the small perforations in the side of the tray were encased in capillary tubes. The extremities of the wires which projected beyond the tray dipped into a small bent tube that contained a solution of the iodide of potassium. In every other respect the experiment was conducted precisely as that which I had performed in 1849. In the course of the experiment, I found that the solution of the iodide of potassium was decomposed; the appearance of the iodide was first made manifest in the limb of the tube into which the wire from the tube containing the *nitric acid* was introduced. From what source was the electricity derived by

which the iodide of potassium was decomposed? There can be no escape, I should think, from the conclusion that the positive electricity was derived from the acid, and the negative electricity from the alkali.

7. The materials with which I operate are necessarily so very small in quantity, particularly when I introduce liquids into glass tubes, that the results, though positive, may be thought trivial. Thus when I introduce nitric acid into a glass tube, I first fill it with acid, which is afterwards decanted, and the tube is kept inverted until all the acid has dropped from it, leaving only as much acid as adheres to the platinum wire and the internal surface of the tube. The quantity of acid which remains is not more than two grains, or one grain and a half; if more than this, the rupture of the tube, when exposed to an intense heat, generally take place. It indeed requires a nice adjustment in respect to the quantity of the materials with which I operate, as well as the requisite hardness and thickness of the tubes which I employ, in order to resist, without fusion and without fracture, the degree of heat to which, in the course of my experiments, they are subjected.

8. In October, 1857, I obtained what I had hitherto failed to procure—those German glass tubes

of the thickness and hardness that I required; and I now proceed to detail those experiments in which the iodide of potassium, contained in the small bent tube, was decomposed by electricity, of which the positive electricity was derived either from an acid, or from oxygen or iodine, and the negative electricity from a metal or an alkali; thus proving that positive electricity is in combination with the first class of bodies, or what are called the supporters of combustion, and negative electricity with the second class, or what are called combustible bodies.

Experiments with Tubes of German Glass.

Exp. 1.—October 22, 1857.

9. Iodide of potassium, decomposed by electricity; the positive electricity derived from nitric acid, and the negative electricity from sodium.

Two tubes hermetically sealed were put into the tray (*Fig.* 2.), both of which were embedded in a mixture of plaster of Paris and finely-sifted coal-ash. One of the tubes contained about two grains of nitric acid, and the other an equivalent quantity of sodium. From the interior of these tubes, platina wires projected beyond the tray, and to prevent the wires from coming in contact with the iron of the tray, they were encased in capillary tubes. These

wires were introduced into a small bent tube, external of the tray, containing a solution of the iodide of potassium (*Fig.* 2). After the tray had been brought to a red heat, the solution itself being kept at a low temperature, the iodide was decomposed; the iodine appearing in the limb of the bent tube, into which was introduced the extremity of the wire which projected from the tube in the tray that contained the acid. It is evident that electricity was the agent by which the iodide was decomposed, and as the iodine appeared in the limb of the tube into which the wire from the acid was introduced, the positive electricity was derived from the acid, and consequently the negative electricity from the metal. In like manner, a solution of the iodide of potassium contained in a similar bent tube, was decomposed by a water battery, the iodine appearing in the limb of the tube into which the positive wire of the battery was introduced.

10. Exp. 2.—December 18, 1857.

The iodide of potassium, decomposed by electricity, of which the positive electricity was derived from nitric acid, and the negative electricity from potassium.

Two grains of nitric acid were introduced into one of the tubes, and an equivalent quantity of

potassium into another. In every respect the experiment was conducted as before, and with precisely the same result.

11. Exp. 3.—January 2, 1858.

The iodide of potassium decomposed by electricity, of which the positive electricity was derived from oxygen, and the negative electricity from potassium.

Two grains of the chlorate of potassa were introduced into one of the tubes, from which oxygen by heat was evolved, and an equivalent quantity of potassium into the other. In the decomposition of the solution in the bent tube, the iodine was first made apparent in the limb of the tube into which the wire from the oxygen was introduced, which indicates that the positive electricity was derived from the oxygen, and consequently the negative electricity from the metal.

12. Exp. 4.—January 16, 1858.

A solution of the iodide of potassium was decomposed by electricity, of which the positive electricity was derived from iodine, and the negative electricity from potassium.

Six grains of iodine were introduced into one of the tubes deposited in the tray, and two grains of potassium in the other. When the tray was brought

to a red heat, the solution of the iodide in the bent tube was decomposed, and the iodine of the solution was first made apparent in the limb of the bent tube into which the wire was introduced that projected from the iodine contained in the tube deposited in the tray.

13. In all these experiments in which the iodide of potassium was decomposed, the iodine of the solution first became apparent in the limb of the tube into which the wire from the tray was introduced in connection with the tube that contained nitric acid, or oxygen, or iodine; which proves that those bodies, when subjected to an intense heat, have their positive electricity, with which they are united, disengaged; and that sodium and potassium, and the alkali, caustic potash, have in like manner their negative electricity, with which they are united, disengaged.

It is obvious that changes had taken place in those bodies when deprived of their respective electricities. Thus sodium and potassium lost their metallic lustre, and were reduced to a black powder, which was inert when thrown upon water, as neither combustion nor action of any kind took place. The nitric acid was deprived of its liquidity, and appeared in small crystals adhering to the platinum wire. The

oxygen which was evolved from the chlorate of potassa ceased to be gaseous, as the tube which contained it, when opened under water, failed to give off bubbles of gas, and a change had also taken place in the iodine, as its presence in the tube which contained it, when heat was applied, could no longer be distinguished by the peculiar characteristic colour of its vapour.

14. I have thus demonstrated by these experiments, *all of which I pledge myself to perform*, that iodine, oxygen, potassium and sodium, are not simple but compound bodies; that in those bodies there are imponderable elements in combination with ponderable elements, and that when deprived of their imponderable elements a change takes place in their properties.

I had now exhausted my supply of those tubes of German glass which for hardness and thickness are available for those experiments, and I must now wait for another supply before I can resume my inquiry into the positive changes which take place in bodies when deprived of their respective electricities.

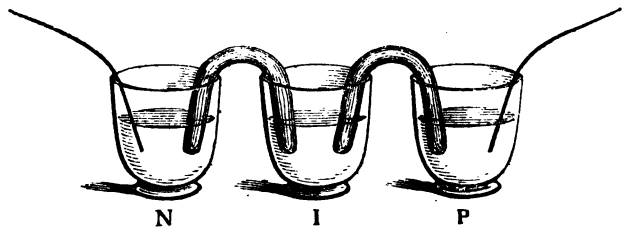
15. It is obvious that the decomposition of the iodide of potassium does not indicate that the bodies which have decomposed it are wholly deprived of the electricity in combination with them. With a

view to withdraw positive electricity absolutely from the acid, and negative electricity from the potassium, I coupled the tube containing the acid which had been used in the decomposition of the iodide, with a tube containing a fresh supply of potassium, and connected their platina wires with each other as is represented in *Fig.* 1, and inferred that the negative electricity, in combination with the potassium, would withdraw, when the tray was brought to a red heat, what remained, if any, of the positive electricity of the acid; and in like manner I coupled the tube containing the potassium, which had also been used in the decomposition of the iodide, with a tube containing a fresh supply of acid, and inferred that what remained of the negative electricity, in combination with the potassium, would be withdrawn by the positive electricity of the acid.

16. The views that I have advanced at the commencement of this Tract on Electro-Chemistry, and the experimental results which I have obtained in corroboration of those views, render the following experiments by Sir H. Davy on the "Transfer of Elements," intelligible.

17. When three cups, N, I, P, are arranged as represented in the woodcut, and the negative wire from a powerful battery is introduced into cup N,

FIG. 3.



and the positive wire into P, the three cups being connected by means of amianthus—how is it, that when a solution of a neutral salt is put into I, and distilled water into the cups N and P, the neutral salt is decomposed, and in every instance the acid base of the salt is decanted into P, and the alkaline base into N? *

The ponderable constituent of the acid in the solution of the neutral salt is attracted to the positive wire in the cup P, and there combining with positive electricity, resumes the properties of the acid; and the ponderable constituent of the alkali is attracted to the negative wire in the cup N, and there combining with negative electricity, resumes its alkaline properties.

18. When N is filled with a solution of the sulphate of potash, and the cups I and P with distilled

* According to the view taken in these notes, of the composition of acids and alkalies, the term *base of the acid* or *base of the alkali* is applied to the ponderable elements of those bodies.

water, the water in I being tinged with a solution of litmus, how is it that, in the decomposition of the sulphate of potash, the acid base of the salt is transferred to cup P, but in passing through the intermediate cup I the blue tincture of litmus does not assume a red colour?

The constituents of a neutral salt possess neither the properties of an acid nor those of an alkali; when, therefore, the sulphate of potash in the cup N is decomposed, the acid base of the salt has not yet acquired the properties of an acid—it has not yet combined with positive electricity; it therefore passes through the solution of litmus in the intermediate cup I, without changing its blue colour into red; and is decanted into cup P, where it combines with positive electricity, and has its acid properties restored. If the contents of the cup P be now poured into the intermediate cup I, the blue tincture of the litmus will assume a red colour.

19. When the cup P is filled with a solution of the sulphate of potash, and the cups N and I with distilled water, the water in I being tinged with turmeric, how is it that in the decomposition of the sulphate of potash, the alkaline base of the salt, in passing through the intermediate cup I on its route to N, does not change the colour of the turmeric?

In the decomposition of the salt, the alkaline base does not possess alkaline properties; it has not yet combined with negative electricity; it therefore does not change the colour of the turmeric in its passage through I. When, however, it reaches the cup N, it there combines with negative electricity, and has its alkaline properties restored. If the contents of the cup N be now decanted into I, the colour of the turmeric will undergo the characteristic change.

20. When the cup I is filled with a weak solution of ammonia, the cup N with a solution of the sulphate of potash, and distilled water is put in the cup P, the sulphate of potash is decomposed; the acid base of the salt being set free, is attracted by the positive wire to the cup P, but in its passage through I it produces no chemical change upon the solution of ammonia; a combination does not take place between the ammonia and the acid base which passes through it. How is this?

The sulphate of potash in the cup N is decomposed, and the acid base of the salt set free is attracted towards the cup P; but in passing through the intermediate cup, it does not combine with the ammonia and form a neutral salt, because the alkali in I requires to give off its negative electricity before its ponderable constituent can combine with the

ponderable constituent of the acid. The ponderable constituent of the alkali has a greater affinity for its imponderable element than it has for the acid base that passes through it. There is therefore no chemical change upon the solution of ammonia in the cup I. When, however, the acid base of the sulphate of potash reaches the cup P, it there combines with positive electricity, and has its acid properties restored. If the solution in P, which is now a solution of sulphuric acid, be decanted into I, the positive electricity of the acid will unite with the negative electricity of the alkali, heat being the product; and the residual constituents of acid and alkali will now combine and form a neutral salt, namely, the sulphate of ammonia.

21. When a solution of the nitrate of potash is placed in the cup P, distilled water in N, and sulphuric acid in I, the nitrate of potash is decomposed, and the alkaline constituent of the salt is drawn through the cup I without undergoing any change itself, or causing any change in the acid. What is the reason of this?

The alkaline constituent of the salt when it enters the cup I, containing sulphuric acid, does not combine with that acid. The sulphuric acid requires to be disunited from its positive electricity before it can

combine with the alkaline base of the salt. When, however, the alkaline base passes to cup N, it there unites with negative electricity, and has its alkaline properties restored. If now the alkaline solution in N be poured into cup I, the positive electricity of the sulphuric acid will unite with the negative electricity of the alkali, and the base of the acid and the base of the alkali will now unite and form a neutral salt.

22. When a solution of the sulphate of potash is put into the cup N, distilled water in P, and a solution of baryta in I, the sulphate of potash is decomposed, and the base of the acid, one of the constituents of the salt, is attracted by the wire in P, and is liberated; but the base of the acid does not pass through the solution of baryta as it passed through the solution of ammonia, but combines with the base of baryta, and is precipitated. How is this?

The base of baryta has the greatest affinity for the base of sulphuric acid, insomuch that it separates the base of that acid from all the alkalies and alkaline earths with which it combines, namely, from strontia, potassa, soda, lime, magnesia, and ammonia. To account, therefore, for the precipitate in I, the base of baryta having a greater affinity for the base of sulphuric acid than it has for the negative electri-

city with which it is united, the baryta is decomposed, the negative electricity is set free, and the base of the acid is arrested in the intermediate cup I by combining with the base of baryta, and because of this a precipitate of the sulphate of baryta takes place.

23. When an acid and an alkali are brought into contact, how is it that great heat is evolved and a compound formed, possessing neither the properties of an acid nor an alkali?

The acid, in combining with an alkali, gives off its positive electricity, and is thus deprived of that which imparted to it the properties of an acid; and the alkali, in combining with an acid, gives off its negative electricity, and is thus deprived of that which imparted to it alkaline properties; and because of this a compound is formed by the combination of the ponderable constituents of the acid and alkali—possessing neither alkaline properties nor those of an acid, and the great heat evolved is consequent upon the union of the two electricities which are given off.

24. If a platinum capsule, which contains a solution of caustic potash, be connected with one wire of an electrometer, and a slip of platinum connected with the other wire is dipped into nitric acid, and

introduced into the potash, why does the capsule in contact with the alkali indicate the presence of negative, and the slip of platinum in contact with the acid indicate the presence of positive, electricity?

The acid, in combining with the alkali, gives off its positive, and the alkali, in combining with the acid, gives off its negative, electricity; and therefore the slip of platinum in contact with the acid indicates the presence of the former, and the platinum capsule in contact with the alkali the presence of the latter, electricity.

25. In double decompositions, as in the case of the two neutral salts when they decompose one another, in which the acid base of the one combines with the alkaline base of the other respectively, how is it that these combinations give rise to no heat, and no current of electricity?

When an acid and an alkali enter into combination and form a neutral salt, they give off their respective electricities, heat being the product; and therefore in double decompositions, when the two neutral salts decompose one another, and enter into new combinations, the constituents of these salts have no electricity to give off, and because of this they give rise to no heat and no current of electricity.

26. When an acid decomposes a neutral salt by combining with the alkaline base of the salt, how is it that the acid base which is set free has its acid properties restored? The acid which decomposes the neutral salt, in combining with the alkaline base of the salt, gives off its positive electricity to the base of the acid which is liberated, and because of this the acid base which has been set free has its acid properties restored. In the same manner the alkali which decomposes a neutral salt gives off to the alkaline base which is liberated its negative electricity, and because of this the alkaline base which has been set free has its alkaline properties restored.

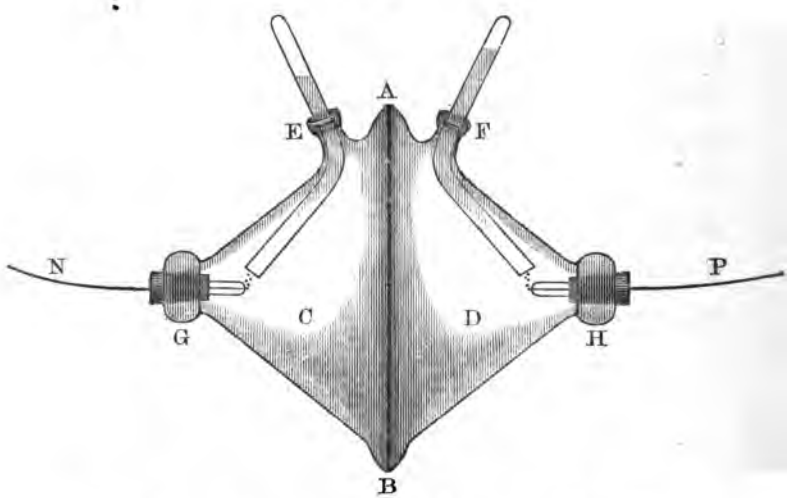
27. *Hydrogen obtained from water without oxygen, and oxygen from water without hydrogen.*

28. Is water a binary compound, and are oxygen and hydrogen the constituents of that body? Or is it a binary compound, which, when under electro-decomposition, one of its constituents combines with positive electricity, and oxygen is the product; and the other constituent combines with negative electricity, and hydrogen is the product?

29. Or is it an elementary body, which, when under electro-action, positive electricity combines

with the water, and oxygen is the product; and negative electricity combines with the water, and hydrogen is the product? With a view to the solution of this last question, I made the following experiment:—

FIG. 4.



30. *Fig.* 4 represents a glass vessel with two compartments, C and D; these compartments are separated from each other by a platinum plate, A B, ten inches in diameter. The compartments are water-tight, insomuch that water, when poured into one of the compartments, has no communication with the other. G and H, are two tubulures, into which stoppers are tightly fitted, and through which the

wires from a galvanic battery are introduced into the vessel — the negative wire into the compartment C, and the positive wire into D. These wires, as they pass through the stoppers, are encased in capillary tubes, with only their extremities exposed. The vessel has two tubulures, E and F, into which tubes are inserted which have their upper extremities sealed. These tubes are bent at their lower extremities to collect the gases which come off from the respective wires of the battery. The cells of the battery which I employ, are filled with spring water, and the glass vessel with water that has been distilled. It is evident that gas will come off from the extremities of both wires of the battery, just as if no platinum plate was interposed—platinum being a conductor of electricity; and it is obvious that whatever quantity of electricity is concentrated at the extremity of either wire, an equivalent quantity of electricity will be induced upon the surface of the plate opposite to the wire, and I experimentally found that this induced electricity was diffused over the surfaces of the plate. And as oxygen and hydrogen are not given off from the wires of a battery when the electricity is low in intensity and small in quantity, I therefore inferred that when the power of the battery was so very low that the

gases were sparingly given off from the respective wires of the battery, the induced electricity of the plate, consequent upon its distribution over so large a surface, would be so attenuated, so low in intensity and so small in quantity, at any one point of its surface, that neither oxygen nor hydrogen would be given off from the plate, and therefore when hydrogen was eliminated from the negative wire, oxygen would not be given off from the surface of the plate presented to that wire; and also that oxygen when eliminated from the positive wire, hydrogen would not be given off from the surface of the plate presented to that wire; and thus hydrogen might be obtained from water without oxygen, and oxygen from water without hydrogen.

31. Since May, 1856, nearly two years ago, a constant stream of hydrogen has been given off from the negative wire of the battery, and also a constant stream of oxygen from the positive wire; but not a bubble of gas, during all that time, has appeared upon either surface of the platinum plate, or upon the sides of the vessel. I have tested again and again the gases which are collected in the tubes contained in the glass vessel, and I find that it is hydrogen which comes off from the negative, and oxygen from the positive, wire of the battery, and

not a mixture of the two gases, as some have supposed. It may be said, that the positive electricity which is induced upon the surface of the plate opposite to the negative wire of the battery, gives off to the water oxygen, which is aborbed by it, and therefore is not apparent; but I would infer that after two years' action, or nearly so, of the battery, the gas would have been visible somewhere; but not the slightest trace can I find of oxygen in the compartment of the vessel in which positive electricity is induced upon the plate, nor of hydrogen in the other compartment, in which upon the plate negative electricity is induced. It would appear that the electricity is so low in intensity, and so small in quantity at any one point upon the surface of the plate, that the gases are not eliminated.

32. In the compartment of the glass vessel in which oxygen comes off from the positive wire of the battery, there appears a growth or a green deposit in the lower part of the vessel, and also in the lower part of the other compartment the water has assumed somewhat of a red colour. How this is to be explained, I do not know. As the experiment, however, still goes on and may continue for years, I have no doubt but that these appearances will be accounted for.

NOTES ON THE TWO ELECTRICITIES.

33. Is heat a binary compound? And are its elements the two electricities?

34. When the two electricities combine, what is the product? Is it not heat?

35. If heat is a binary compound, of which the elements are the two electricities, is it by the decomposition of heat that ordinary electricity is evolved?

36. If ordinary electricity is evolved by the decomposition of heat, what is the process by which the common elcctrical machine is made to give off electricity? Is the heat which is excited by the friction of the rubber upon the glass cylinder decomposed, the heat being interposed between two bodies, of which one has an affinity for positive and the other for negative electricity; the glass of the cylinder being the one that attracts and carries off the positive electricity, and the silk of the rubber the other that attracts and gives off the negative electricity?

37. It is the opinion of some of our lecturers on chemistry, that the electricity manifested by the

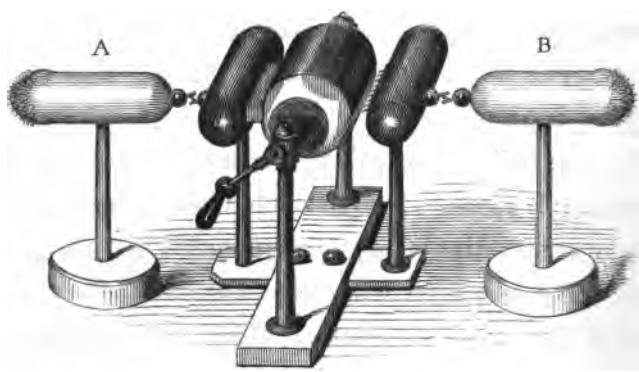
electrical machine is derived from the ground, and not from the machine itself; also in some of our standard works on chemistry, as well as those on electricity, the same opinion obtains. Thus in Sturgeon's lectures on electricity, the following statements are made:—"When the cushion is in metallic connection with the ground by means of the copper wire, or when the hand is placed on it, it gets an abundant supply from that source." Again, "I have already stated in a former lecture, that the insulated cushion or rubber of a machine yields but a small portion to the revolving glass, because of a want of supply from the ground." Also in one of our standard works on chemistry, it is there stated "that when one conductor is un-insulated, the electricity derived from the other is proportionably augmented; in the positive conductor, because then the other draws uninterrupted supplies from the earth."

38. The following experiment proves that this opinion is erroneous.

To the ball of the prime conductor of an electric machine I presented an insulated conductor B, one of the extremities of which terminated in a metallic ball, and was placed within less than an inch of the ball of the prime conductor. The other extremity terminated in numerous points or needles. A similar

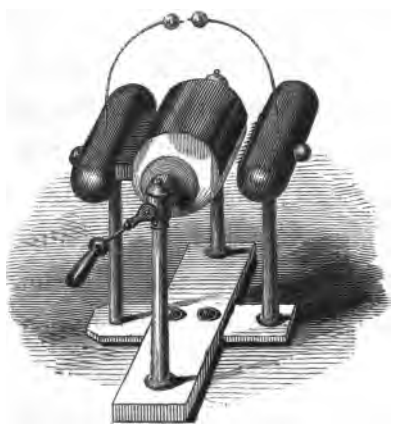
conductor A, similarly situated, was presented to the ball on the negative side of the machine. The whole apparatus was supported upon glass pillars and had no electrical communication with the ground by means of a chain or otherwise. Upon turning the glass cylinder of the machine, a constant succession of sparks took place between the ball of the prime conductor of the machine and the ball of the insulated conductor B, as also a constant succession of sparks took place between the ball at the negative side of the machine and the ball of the insulated conductor A, and by continuing to work the machine a rapid succession of sparks for any length of time was maintained.

Fig. 5.



39. But in this last experiment, it is said that the metallic points which project from the conductors A and B withdraw electricity from the atmosphere which is imparted to the machine, and this is indicated by a constant succession of sparks that takes place between the balls of the conductors A and B, and those of the machine itself. That this view is also erroneous. I removed from their place the conductors with the metallic points, and into the upper part of each of the conductors of the machine I inserted the extremity of a brass wire, the other extremity of which terminated in a brass ball; the wires with the balls were made to bend towards each other as is represented in *Fig.* 6.

FIG. 6.



I found by this addition to the electrical machine, that upon turning the glass cylinder a constant succession of sparks took place between the balls. As the common electrical machine has all its projections rounded off, it does not, when insulated, give off with facility electricity to the atmosphere, or to the surrounding bodies, or withdraw electricity from them. This constant succession of sparks between the balls, must therefore be derived from the machine itself. In order to prove that the electricity thus made manifest was not derived from the atmosphere, I replaced the conductors with the metallic points in their former position, connecting, however, the balls at their extremities with the balls of the conductors of the machine. Upon again turning the glass cylinder, the electric sparks between the balls (*Fig.* 6) did not now take place. It was therefore obvious that the metallic points of the insulated conductors, instead of supplying additional electricity to the machine by withdrawing it from the atmosphere, withdrew electricity from the machine, and gave it off to the atmosphere; and in a dark room this was indicated by the appearance of minute sparks of electricity at the metallic points of the conductors.

40. If heat is a binary compound, of which the elements are the two electricities, is it by the decom-

position of heat that electricity by induction is evolved?

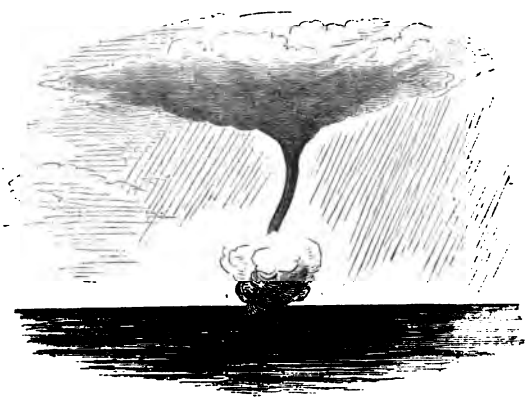
When a body is charged with one of the two electricities, electrical induction takes place in the body to which it is presented—is the heat of the induced body decomposed, one of the constituents of which is attracted, and the other repelled, by the adjacent body charged with one of the two electricities?

I may state one or two examples of electrical induction as, I conceive, they occur in nature. When a cloud charged with one of the two electricities passes over the spire of a church, the spire by electrical induction is charged with the opposite electricity; and when the attraction of the two electricities, that of the cloud and that of the spire, is such as shall overcome the low conducting power of the atmosphere, the electricity of the cloud descends and unites with the electricity of the spire, and thus, in common parlance, the spire is said to be struck with lightning.

Again, when a cloud charged with one of the two electricities passes over the surface of the ocean, it induces the opposite electricity in the water beneath; and because of the attraction of the two electricities, that of the cloud and that of the water beneath, the

water rises above its level towards the cloud, and the cloud in a column descends; and thus is exhibited the remarkable phenomenon of what is called a waterspout. (*Fig.* 7.)

Fig. 7.



TRACT

ON

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42. Do self-luminous s

distances repel each other, but beyond those distances have they a tendency to gravitate towards each other? And is it because of these antagonist forces, that stars are found associated together in clusters, and not concentrated into one self-luminous or incandescent mass?

43. Does the form of those nebulæ (*Fig.* 8) point out the direction in space to which they trend? Does each visible star in its motion of translation in space draw after it the nebula with which each is associated?

FIG. 8.

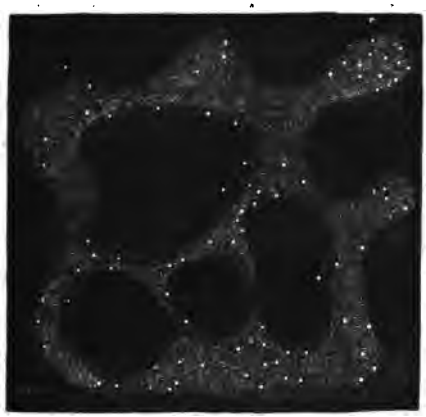
NEBULÆ WITH ONE VISIBLE STAR.

44. Do those visible stars, which are so often found associated with unresolved nebulæ, determine in any way the forms of those nebulæ?

45. Has the form of the reticulated nebula (*Fig.* 9) been determined by the position of the visible stars with which it is associated?

FIG. 9.

RETICULATED NEBULA.



46. Is it so, that the unresolved nebulæ (*Fig.* 8) are made to converge towards the visible star with which each is associated, but to diverge in the opposite direction, because no star is there situated by which the nebulæ might be made to converge in that direction?

FIG. 10.

NEBULÆ WITH BINARY STARS.

47. Is it so, that the nebulæ (*Fig.* 10) because of the attraction of the binary stars with which they are associated, converge in opposite directions towards those stars?

48. If so, how is it that the unresolved nebula (*Fig.* 11) which is only associated with one visible star, situated at one of its extremities, does not diverge in the opposite direction as the nebulæ (*Fig.* 8), but is made to converge at both extremities as the nebulæ (*Fig.* 10) which are associated with binary stars? Is it from this cause the nebula (*Fig.* 11) is also associated with a binary system, of which the star at one of the extremities is self-luminous, but the star at the other extremity is dark or benighted?

FIG. 11.

A NEBULA WITH ONE VISIBLE STAR.

49. In what circumstances might we infer that dark stars do exist in the sidereal heavens?

50. Were a visible star to disappear from one of the extremities of one of the nebulæ (*Fig.* 8), and

were the nebula from which the star had disappeared to maintain the same convergence as before, towards the point at which the star had ceased to be visible —would the inference be legitimate, that the star which had disappeared was not annihilated, but had ceased to be self-luminous?

51. If at the starless extremity of the nebulæ (*Fig.* 11) a star became visible, might we not infer that this new star was not a new creation; but, before its appearance, had existed at the extreme point of this nebula, a non-luminous body?

52. Were one of the stars, of a binary system, that revolved about a common centre of gravity, to disappear from our firmament, and were the star which remained visible to preserve the same orbit that it maintained while revolving with its partner before the disappearance took place—would not this go to prove, that the star, which had disappeared, was not annihilated but only darkened?

53. The great astronomer, Bessel, has demonstrated that both Sirius and Procyon are binary systems, that each has a revolution about a common centre of gravity, but that the partner of each is a dark or benighted star.

54. Since the fact has been revealed to us that dark stars do exist in the firmament, when therefore

a self-luminous star disappears from the heavens, is it not more legitimate to suppose that the star which has ceased to be visible, has been darkened rather than annihilated? And when a new star appears in the heavens, is it not more legitimate to suppose, that a dark star in the firmament has become self-luminous, than to suppose that this new star is a new creation?

55. How is it, that during the historical period of astronomical science, stars have disappeared from our firmament, and remain still invisible? And stars, that were before invisible, are now self-luminous? Is it from this cause: In the sidereal heavens an economy obtains of *Astral Days* and *Astral Nights*, and because of this, every star in the firmament undergoes, at distant intervals, a periodic change from light to darkness, and again from darkness to light?

56. Captain Jacob, of the Madras Observatory, in a revision of a portion of the British Association's Catalogue of 8,377 Stars, has made the remarkable discovery, that 46 of those stars, whose positions had been determined, are missing. Is it so, that those stars are now benighted stars, that they have ceased to be self-luminous, because their *Astral Night* has set in upon them?

57. As our sun is a star, if therefore every star in the firmament undergoes, at distant intervals, a periodic change from light to darkness, and again from darkness to light, then are proofs to be found in the crust of the earth, which go to establish the remarkable fact, that in the past history of our globe there has occurred the alternate succession of *Solar Days* and *Solar Nights?*

58. If so, is the number of *Solar Days* and *Solar Nights*, which Nature in the history of our globe has recorded, just equal to the number of geological systems, of which the crust of the earth is mainly constituted?

59. And if so, was the duration of a *Solar Day* just that period in which the series of strata that constitutes a geological system was deposited? And was the duration of a *Solar Night* just the interval that occurred between the deposition of one geological system and the commencement of the deposition of another—the next in succession?

60. Or was that period in which the animals and plants belonging to the same creation continued to exist—the duration of a *Solar Day?* And was the interval that occurred between the extinction of one creation of animals and plants and the commencement of another creation, the next in succession—

the duration of a *Solar Night?* In fine, was a geological period just the duration of a *Solar Day,* and was the interval that occurred between two consecutive geological periods the duration of a *Solar Night?*

61. If a period has intervened between the deposition of one geological system and the commencement of the deposition of another, the next in succession—what has been the cause of this remarkable *break* that has thus occurred in the building up of those stratified masses which mainly constitute the crust of the globe? How came it, that after the series of strata which constitutes a geological system had been deposited, the precipitation of sedimentary matter upon the bed of the ocean was suspended? What was it that bound up the soil, or locked up the rivers, by which earthy matters ceased to be conveyed to the channels of the deep —and what stayed the waves of the ocean by which the rocks upon the sea-shore ceased to undergo further abrasion? And how came it that at this period Death had asserted his dominion over all that is sentient in Nature? Was it because of this—the sun was darkened, and the earth became frigid, and the rivers were frozen, and the ocean transformed into a mass of ice—and thus a breach was made in

the continuity of deposit, while every living thing that had existed perished, whether a denizen of the air, the earth, or the waters?

62. Were the solar nights the glacial periods of geologists? If so, how is it that there is not the slighest trace of glacial action observable in the earliest geological formations? Is it from this cause —the innate temperature of the globe at the commencement of our geological history was such, that when a solar night did occur, the earth did not become frigid?

63. As the seeds of plants must have existed in the soil, and the spawn of fish in the ocean, at the close of the more modern geological periods—how is it that the vegetative principle of the one, and the vital principle of the other, must have both been destroyed during the interval that occurred between two consecutive geological periods, inasmuch as the various species of fish and of plants that are found to occur in any one geological epoch, are not *identical* with those which are found in that which immediately precedes it? Is it because of this — the seeds of plants and the spawn of fish were subjected to a cold so intense during the interval that occurred between the deposition of one geological system and the commencement of the deposition of another, the

next in succession, that the vegetative principle of the one, and the vital principle of the other, were both destroyed?

Agassiz states that with respect to the fishes of the tertiary epoch, "I have not yet found a single species which was perfectly identical with any marine existing fish except the little species which is found in nodules of clay of unknown geological age in Greenland."

64. If an economy obtains in the sidereal universe of *Astral Days* and *Astral Nights*, then, since the dawn of this our *Solar Day*, have six thousand years not yet passed away; or have six thousand years not yet passed away since "darkness brooded o'er the deep," and God said "Let there be light, and there was light"?

ON THE ALTERATION IN THE POSITION OF STRATIFIED ROCKS.

65. What has been the cause of the alteration that has taken place in the position of the earth's strata from that which was originally horizontal to that which is vertical; or, if not, to a position more or less inclined to the horizon? As the igneous rocks

were forced from beneath, not in the mass as they are seen by us on the surface of the globe, but in a state of fusion through clefts or fissures in the crust of the earth, and which are represented to us in geological sections as not of great width, is it so that the formation of those clefts or fissures is a sufficient cause for the bendings or inflections of strata throughout entire districts, and at distances from those fissures often very remote?

66. If a displacement of the strata in the crust of the earth from their original horizontal position to a position more or less inclined to the horizon, has been effected by the upheaving of igneous matter from beneath, how comes it that entire districts of country do occur in which this alteration in the position of the strata has taken place, but in which geologists have not discovered throughout the whole extent of those districts any trace whatever of igneous rocks or igneous action?

67. Which is the cause or which the effect? Was it by the eruption of igneous matter from beneath that the strata were made to shift from a horizontal position to a position more or less inclined to the horizon? or was it under the pressure and friction of enormous masses of strata while shifting from a horizontal to an inclined position, that the

subjacent rocks were subjected to a heat so intense that their fusion was effected and their eruption took place?

68. If in the remote past, the temperature of the globe was greater than it is now, will not the density of the globe, because of this, be greater now than it was then?

69. If the innate temperature of the globe, as some philosophers suppose, has been in a state of constant decrease, will not the density of the globe, because of this, have been in a state of constant increase?

70. Does not the oblate spheroidal figure of the earth go to prove that, in the remote past, our planet was less dense than it now is, and therefore the magnitude of the globe was greater then than it is now?

71. Humboldt, in his "Cosmos," states "that many of the phenomena presented by our own planetary system lead to the conclusion that the planets have been solidified from a state of vapour." If our globe has passed from a state of vapour to that of a solid, or its present state of condensation, must it not have passed through all the intermediate states?

72. Has our planet, during the whole course of its past history, ceased not to increase in density, and therefore ceased not to diminish in magnitude?

73. If so, then is it because of the great lateral pressure which the circumference of a sphere undergoes, when that sphere ceases not to increase in density, and therefore ceases not to diminish in magnitude, that has induced those bendings and inflecflections, or changes of position, which have taken place in the strata of the crust of the earth since the period of their deposition?

74. Dr. M'Culloch, in his "Geology of the Western Isles," has made two representations of strata of gneiss which occur in the Island of Lewis, and which have shifted from their original horizontal position, or that position in which they were deposited, to one that is highly inclined and incurvated. (See *Figs.* 12 and 13.)

Fig. 12.

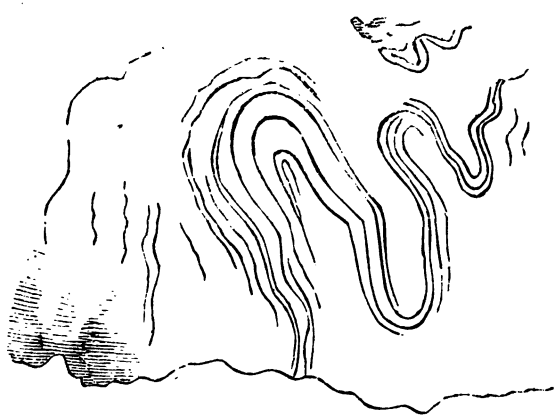


FIG. 13.

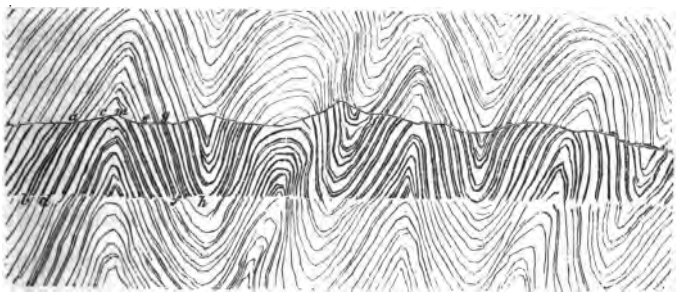
Now these strata, with their inflections, were they extended and restored to their original horizontal position, would be subtended by a horizontal base three times greater than that which they now subtend. Whence this contraction of base? Is it because the magnitude of the globe was very much greater when the strata of gneiss were deposited than it is now, and therefore the strata, if soft by virtue of the lateral pressure induced by the contraction of the circumference of the globe, would undergo bendings and inflections while accommodating themselves to the nucleus of a globe, which ceased not to diminish in magnitude? Is it thus, that the horizontal base which subtended the strata of gneiss during the period of their deposition was so much greater than that which they now subtend?

75. If so, what was the magnitude of the globe at the period when gneiss, the first of stratified rocks, were deposited?

76. Sir James Hall, in the "Edinburgh Phil. Transactions," vol. vii., has made a representation of

curved strata of slate, that belong to the transition class of rocks, and which occur near St. Abb's Head. (*Fig.* 14.)

Fig. 14.



There are sixteen distinct bendings in the course of six miles. Now were those strata extended and restored to their original horizontal position, in place of being subtended, as they now are, by a horizontal base of six miles, they would be subtended by a horizontal base of about ten miles and a half. Whence this contraction of base? May it not be explained, as before, upon the supposition, that the globe has undergone an increase of density, and therefore a diminution of magnitude, since those strata were deposited? and as the horizontal base which subtended the primitive strata of gneiss when they were deposited was fully three times greater than that which now subtends them, whereas the

horizontal base which subtended the transition strata of slate when they were deposited was only about twice the extent of base which now subtends them, that therefore the strata of gneiss were deposited upon a globe, the magnitude of which was greater than that upon which the transition strata of slate were deposited, and because of this the strata of gneiss suffered a greater contraction of base than the transition strata of slate while adjusting themselves to the nucleus of a globe which, since their formation, had constantly diminished in magnitude?

77. If so, what was the magnitude of the globe when the transition strata of slate were deposited?

78. The alterations that have taken place in the position of strata since they were deposited have been referred by geologists to the intrusion of igneous matter into the crust of the earth. The undulations of the strata are supposed to have been induced by that lateral pressure which the adjacent rocks would undergo when a disruption of the strata took place in the formation of the fissure through which the igneous matter was discharged. The strata represented in *Fig.* 14 have by their inflections suffered a contraction of horizontal base, equal in extent to four miles and a half. This contraction of the base

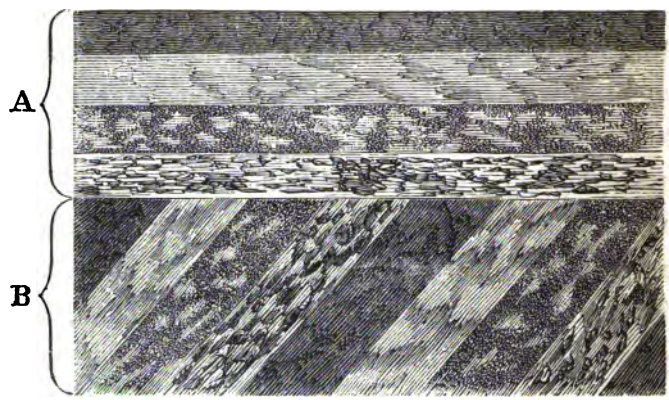
could not have been greater than was commensurate with the width of the fissure through which the molten matter was discharged. Now in geological sections, the fissures through which the igneous matter is discharged, are represented as not of great width, and quite inadequate to have induced by a lateral pressure those undulations which often extend over a whole district of country.

79. What is true in respect to the primitive and transition strata holds true in respect to the secondary and tertiary classes of rocks, inasmuch as the horizontal base which subtended those strata when they were deposited was greater than the horizontal base which now subtends them, while this difference in respect to the horizontal base of the tertiary strata is less than that of the secondary rocks; and, as a general law, the difference is always the greater, according to the seniority of strata in respect to the period of their deposition. How is this? May it not be explained, as before, upon the supposition, that, during the formation of the crust of the earth, the nucleus of the globe has ceased not to undergo a constant increase of density, and therefore a constant diminution of magnitude?

80. What has been the cause of that want of conformability which is found so often to occur

between the strata of two consecutive geological systems? How came it that after the last member of a geological system had been deposited, the strata of that system shifted from a horizontal position to one so much inclined to the horizon that the first member of the subsequent formation was deposited upon the edges of those strata? Was it,

FIG. 15.



that during the interval which elapsed between the deposition of one geological system and the commencement in the deposition of another—the next in succession—the sun was darkened; and as the earth during the period in which the solar rays were withdrawn would radiate heat to distant space, and receive no heat *ab extrâ* in return, the globe would suffer so great a diminution of temperature that its

density would increase, and therefore its magnitude would diminish; and because of this, the strata last deposited, when subjected to that lateral pressure which is induced at the circumference of a sphere while that sphere undergoes a diminution of magnitude, would shift from a horizontal to an inclined position, while adjusting themselves to the nucleus of a globe which had thus diminished in magnitude? Is it thus that the strata of one formation are so often found to lie uncomformable with the strata of a prior formation upon which they are recumbent?

The questions which follow in reference to the alteration that has taken place in the position of strata since the period of their deposition, are inserted from a paper which I contributed to "Blackwood's Magazine," and which appeared in the October number of that journal so long ago as 1819, entitled "Predictions by C. C."

81. How is it "that strata which were originally horizontal in their position are now inclined to the horizon?" Is it because "our globe has suffered a constant diminution of magnitude since the strata were deposited which everywhere encompass it; and, therefore, since those strata at their formation would form as it were the circumference of a larger globe, and are now circumscribing the nucleus of a

less, they would, if soft, suffer bendings and inflections while accommodating themselves to a globe constantly diminishing in magnitude; and if indurated, they would break asunder, and assume a position somewhat inclined to the horizon; and as the globe diminished more and more in magnitude, the strata would approach more and more to a vertical position?"

82. How is it that "strata deviate the more from the horizontal position as they are the more ancient?" "If this globe has constantly diminished in magnitude, then the more we recede from the present period the greater will be its magnitude, and, consequently, the more ancient the strata, the greater would be the globe upon which they were deposited. Since, therefore, strata, according to their seniority, would, when deposited, form as it were the circumference of a larger globe, and they are now all investing the same nucleus, and that the nucleus of a less, it is evident that the strata last formed would require to shift less from their original horizontal position, in order to accommodate themselves to the present magnitude of the globe, than strata of a prior formation; that, therefore, the more ancient the strata, the more must they be displaced from their first position; the primitive strata must have there-

fore assumed a position more highly inclined to the horizon than those of a subsequent formation."

83. "Are earthquakes just the shifting of strata while accommodating themselves to a globe which is constantly diminishing in magnitude?"

84. "Was the substance of a vein originally diffused throughout the strata which include the vein, and which has been expressed from the strata after the formation of the fissure which now contains it?"

ON THE FORMATION OF LIMESTONE BEDS.

85. What is the origin of those beds of limestone which are found associated with the members of the various geological formations? As beds of limestone are not the result of a mechanical deposit, but of a chemical precipitate, must not the formation of those beds be accounted for, not upon mechanical, but chemical principles?

86. It is a fact well known to chemists, that two equivalents of carbonic acid gas, when subjected to a given pressure, will combine with one equivalent of lime, when held in solution, and form the bi-carbonate of lime—a salt that is soluble in water; and should the pressure be afterwards removed, one of

the equivalents of the bi-carbonate will be given off, and the other equivalent will remain in combination with the lime, which is the carbonate of lime—a salt that is insoluble in water—and is, therefore, precipitated. If, therefore, the ocean, at a remote period, held lime largely in solution, as some geologists suppose, and carbonic acid gas escaped then, as it does now, from clefts or fissures in the crust of the earth, it is evident, that if, at a great depth, this gas escaped from a fissure at the bottom of the ocean, it would combine with the lime in solution, and, under the great pressure of the superincumbent waters, would form the bi-carbonate of lime—a salt that is soluble in water. Now, as every soluble body has a tendency to diffuse itself through the menstruum in which it is dissolved, the bi-carbonate of lime, thus formed, would diffuse itself in the waters laterally and vertically, the vertical diffusion being co-extensive with the lateral diffusion; but during the diffusion of the bi-carbonate of lime towards the surface of the ocean, the superincumbent pressure of the waters would be gradually removed, until, at length, the bi-carbonate would part with one of its equivalents of carbonic acid gas, and would thus be reduced to a carbonate of lime, which, not being soluble in water, would be preci-

pitated: and hence a bed of limestone, co-extensive with the lateral diffusion which had taken place in the ocean of the bi-carbonate of lime, would be formed.

87. During the process, which we have just described, by which the bi-carbonate of lime is reduced to a carbonate, a quantity of carbonic acid gas is given off, precisely equal to the quantity of carbonic acid gas which is precipitated with the lime in the formation of a limestone bed; that while one equivalent of carbonic acid gas is precipitated with the lime, the other equivalent of the gas is given off, to enter into the composition of the atmosphere.*

88. As the carbonate of lime is insoluble in water, whence was it that the encrinites of the mountain limestone derived their carbonate of lime? Was it from a bi-carbonate of lime which the ocean held in solution that those encrinites derived their calcareous matter? Was the bi-carbonate decomposed, of which one equivalent of carbonic acid gas in combination with the lime was appropriated by

* An analogous process takes place in calcareous springs which are charged with the bi-carbonate of lime—one equivalent of carbonic gas is given off to the atmosphere, and the other equivalent in combination with the lime is precipitated.

the encrinites, while the other equivalent of carbonic acid gas was given off to the atmosphere?

89. If so, was it during the formation of the enormous beds of mountain limestone, when the bi-carbonate of lime, according to the process we have described, was reduced to a carbonate, that the surplus carbonic acid gas, which would thus be given off to the atmosphere of the carboniferous period, would be fully adequate to provide for the growth of the luxuriant vegetation of that period?

90. How is it that the limestone which occurs in primitive rocks seldom consists of extended beds, but is found in lumpish masses that are included in those rocks? Is it from this cause—the primitive limestone was deposited in shallow water, when the ocean enveloped the whole globe; and because of this, when carbonic acid gas escaped from a fissure at the bottom of the ocean, the pressure of the superincumbent waters was not such as to cause the carbonic acid gas to combine with the lime in solution to form a bi-carbonate, but a carbonate of lime? There would be thus little or no lateral diffusion, as the carbonate of lime, when formed, would be immediately precipitated, and thus lumpish masses of limestone would be formed, and not extended beds.

ON THE FORMATION OF MURAL CLIFFS.

91. There is one characteristic of mural cliffs, which, so far as my observation goes, is common to all, whether those cliffs occur inland or upon the sea-shore. At the base of those cliffs, and along the whole extent of the base, a stratum of rock occurs of softer consistency than the superincumbent rock. When, therefore, a series of strata, somewhat inclined to the horizon, is situated upon the sea-shore, with their escarpments exposed to the action of the waves, and the inferior stratum is composed of softer material than the superincumbent rocks, the stratum of softer consistency undergoes a more rapid abrasion than the rocks above; and because of this, those rocks are left unsupported, and from time to time give way, and thus a mural cliff, with a perpendicular face, is formed.

92. On those parts of the coast where the sea has made rapid encroachments upon the dry land, I have observed that this occurs more particularly where a cliff rests upon a thin stratum of rock, of which the consistence is of softer material than the rock of which the cliff is composed. The sea ex-

cavates the softer stratum at the base of the cliff, and the superincumbent rock, being left unsupported, gives way.

Now, might not this inroad of the sea upon the dry land be prevented, and that, too, at a trivial cost, by building up with concrete masonry the excavated part of the stratum at the base of the cliff, which is often not more than one or two inches in thickness? and thus the further abrasion of the softer stratum, upon which the cliff is recumbent, would be kept in abeyance, and the further encroachment of the sea effectually prevented.

93. A mural cliff of sandstone occurs upon the sea-coast near the city of St. Andrew's. The cliff extends from the baths of that city westward, and rests upon a thin stratum of coal. The sea excavates the coal at the base of the cliff, and the superincumbent rock gives way. It is said, that at one period the sea made such rapid encroachments at this place that the inhabitants contemplated the construction of a breakwater, with a view to the protection of the cliff. Now, might not the further demolition of the rock be easily and effectually prevented by building up, with solid masonry, the exposed part of the coal-bed, which is not more, as far as my recollection goes, now fifty years ago,

than six inches in thickness? The coal would thus be protected from further abrasion, and the further demolition of the cliff prevented.

94. A mural cliff consisting of basalt, called the King's Craig, is situated between the towns of Burntisland and Kinghorn, and is considerably elevated above the present level of the sea. At the bottom of the craig, a thin stratum of coal, about an inch in thickness, extends the whole length of the base. Now, whence came the perpendicularity of that rock? and whence its mural aspect? Was that rock, at a former but remote period, exposed to the action of the waves? and because of this, the stratum of coal at the base of the cliff would undergo a much more rapid abrasion than the rock above; and, therefore, the exposed part of the superincumbent rock would, from time to time, be left unsupported, which, giving way, a mural cliff presenting a perpendicular face would be formed?

ON CAVES.

95. What is the origin of those caves which occur in the cliffs upon the sea-shore, and which present somewhat the form of a hollow sphere? Are they formed thus—In a cave which presents

such a form, I have observed, that in the rock in which it occurs, a rent or cleft extends along the roof of the cave from the mouth inwards into the rock above; and when the sand and gravel at the bottom of the cave is removed, the same cleft is found to extend from the mouth of the cave inwards into the rock? If, therefore, this cleft existed in the rock before the cave was formed, the waves, as they dashed at random upon the sea-shore, would carry along with them particles of sand, which, as they penetrated the cleft in the rock, would widen it by their attrition, and would continue to enlarge it, until at length gravel as well as sand would be dashed in by the waves; and while the particles of sand were

Fig. 16.

penetrating still further into the cleft of the rock, the

gravel which had entered would be left behind, to give additional width to that part of the cavity that had already been formed. The breach in the rock would, at length, became so large that boulders as well as gravel would be dashed in by the waves, which, during their continued action, would excavate a cavern, the form of which would be that of a hollow sphere.

ON ERRATIC BLOCKS.

96. It would appear that the theory which Sir Charles Lyell has promulgated with the view to account for the transport of erratic blocks—namely, by the agency of icebergs—has not been fully adopted by geologists, as we still read of currents of water and waves of translation as the agents employed in the transport of those blocks.

97. When erratic blocks have been removed to a distance remote from the parent rock, and have, notwithstanding, preserved their angular parts sharp and entire, does not this argue that those massive fragments have been *carried* to the place that they now occupy, and there deposited? that as their edges, during their transport, had not been subjected to attrition, therefore, neither currents of water nor waves of translation were the agents by which those

blocks of stone were impelled forwards to occupy their present position, inasmuch as currents of water, or waves of translation, adequate to the transmission of such masses, must have swept before them all the loose sand and gravel and earthy matters which they met with in their course, and have made that part of the bed of the ocean bare over which they travelled? Those blocks of stone would have, therefore, been impelled forward over a rocky bottom; and because of this, their edges would have been subjected to attrition, and their angular parts rounded off.

In the island of Arran, about a mile east from the village of Lamlash, I found upon the sea-shore blocks of granite of several tons weight. The upper part of each had its angular parts rounded off; but the base of each, which rested upon the level surface of a sandstone rock, was flat, as is here represented.

Fig. 17.

Now, how came it that the sharp edges at the base, during the transport of those blocks, should have escaped abrasion, notwithstanding that the parent rock was six miles distant? Was it because those blocks of granite had been conveyed from the rock *in sitú* upon an iceberg or a raft of ice, with all their angular parts entire, to the place which they now occupy, and there deposited? and as the flat base of each massive fragment rested upon the level surface of the subjacent rock, the sharp edges at the base were thus protected from the possibility of abrasion? The upper portions of the blocks, however, having been exposed to the action of the waves, sand and gravel were dashed upon them, by the attrition of which the angular parts were, in process of time, rounded off.

NOTES ON THE SOLAR SYSTEM.

98. Was it by physical and other appliances, on the part of the Creator, that the works of creation were evolved? Of the three Hebrew words "ברא *create*, עשה *make*, יער *form* or *fashion*; though each of these has its shade of distinction, yet the best critics understand them as so nearly synonymous

that, at least in regard to the idea of making out of nothing, little or no foundation for that doctrine can be obtained from the use of the first of these words."—*Kitto's Cyclopædia—Creation.*

99. There was a period in the history of the world, when the crust of the globe did not exist; and there was a period still more remote, when the globe itself was not. Is it not as legitimate to speculate upon the formation of the nucleus of the globe, and the matter from which it sprang, as to speculate upon the formation of the crust of the globe, and the matter by which it was formed?

NOTES ON COMETS.

100. What are those comets which traverse the solar system in vast eccentric orbits? Are they oceans isolated in space? And because of this is a comet with an eccentric orbit a solid, or a mass of ice as it traverses the region of its aphelion? Is it a liquid as it nears the sun, and is it a vapour as it moves in the region of its perihelion? And is it so, that a portion of that vapour from its proximity to the sun is resolved into steam and thus becomes invisible? After the perihelion passage has taken place, and during the comet's recess from the sun, is

the portion of that vapour, which from its proximity to the sun had become transparent, again by a reduction of temperature made visible, and during the comet's further recess from the sun is the vapour, from a still greater reduction of temperature, condensed into a liquid, and thus the comet without a tail and without a nebulous atmosphere presents itself as a star of inferior magnitude—a bright concentrated point?

Sir John Herschel, in his observations on Halley's comet, which made its appearance in 1835, states, that on the evening of the 28th of October, before the termination of the twilight, he obtained an excellent view of Halley's comet, eighteen days previous to its perihelion passage; its appearance was about that of a star of the third magnitude, which, as the darkness increased, appeared somewhat hazy. In a night glass the tail 3° in length was conspicuous. After the perihelion passage had taken place, Sir John Herschel observed that the comet was actually increasing in dimensions and with such rapidity that it might almost be said to be seen to grow. (The increase in the dimensions of comets in their recess from the sun was pointed out by M. Valz.) In the comet's further recess from the sun the continued dilatation of the comet was ob-

servable. Sir John Herschel says, "I can hardly doubt that the comet was fairly evaporated in perihelio by the heat and resolved into transparent vapour, and is now in process of rapid condensation and re-precipitation on the nucleus. During the comet's retreat from the sun the tail began to be developed. The nucleus became more bulky, hazy, and ill defined, and its tail was strong, which afterwards gradually and entirely disappeared."

Henceforward the comet presented the appearance of a round nebula, highly and very suddenly condensed in the middle, which gradually died away until finally lost. M. Boguslawski, professor of astronomy, sixty days after the perihelion passage, actually observed the comet as a star of the sixth magnitude—a bright concentrated point.

101. Is it not so, that the impact of a comet upon our world is possible; and when we reflect upon the number of comets which traverse the solar system whose aphelion passage is beyond that of our planet, but whose perihelion passage is within the earth's orbit,—is it not so, that the impact of a comet upon our world is probable? Moreover when we consider the ages that have rolled on during the past history of our world, and the countless numbers of comets which have traversed the solar

system during that period, and when we reflect that a comet within a given distance of our planet is less attracted towards the sun than towards the earth,—is it not so, that the impact of comets upon our world must have been inevitable?

102. If the impact of comets upon our world during its past history must have been inevitable, and a comet which traverses the solar system is an ocean isolated in space, is it so that our world has derived its ocean from the visitation of comets?

103. But what are those comets, the discovery of which was made by Encke and Biela? Are they portions of the atmosphere of that planet which by a "cosmical convulsion," is supposed to have burst into fragments; and is it so, that other portions of that atmosphere and other fragments of that planet are still in reserve for future discovery?

104. If a comet which, in its course of revolution about the sun, traverses the solar system, becomes a solid, a liquid, and a vapour,—will more of the sun's rays be intercepted by it when it is a solid or a liquid, than when it is a vapour, and more when it is a vapour than when, from its proximity to the sun, it is resolved into steam and becomes invisible? and is it because the mass of a comet in its course of revolution about the sun never varies, but the impul-

sion of the sun's rays upon it vary, that the comet's orbit is eccentric?

105. If those comets which circulate about the sun in vast eccentric orbits are oceans isolated in space, would the impact of a comet upon our world be a force adequate to produce those phenomena which are presented to us in the formation of the boulder clay?

According to geologists, the boulder clay formation appears to emanate from a common centre, and owes its origin to no ordinary operations of water. It consists of accumulations of sands, gravel, clays, and boulder stones, huddled up in the same indiscriminate mass, without regard to sedimentary deposition, or to gravity, or to any other law of arrangement.

106. When a comet approaches the sun, how is it that the nebulous matter which constitutes the tail, is extended in the wake of that body; and how is it when a comet recedes from the sun, the nebulous matter which constituted the tail, is extended in advance of the nucleus? Is it from this cause: Matter ceases not to be projected from the sun, the momentum of which is such, that as it impinges upon the nebulous atmosphere which surrounds the nucleus of a comet, that atmosphere, during a comet's approach to the sun, is impelled behind and beyond

the nucleus; whereas, when the comet recedes from the sun, the matter which is projected from that body, impels the atmosphere to extend in advance of the nucleus?

107. If matter is projected from the sun, and if all space is pervaded by a resisting medium, as philosophers now suppose, at what distance from the sun will the matter, which is projected from that body, and transmitted through that medium, be brought to a state of rest?

108. As there can be no loss of matter anywhere, but there must be an acquisition elsewhere; if, therefore, matter is projected from the sun, in what region in space is the acquisition made?

109. Is heat matter?

110. Is the solid matter of the solar mass now resolving into heat?

111. If the solid matter of the solar mass is resolving into heat, is there a provision in nature by which again the solar heat is reduced to the condition of solid matter?

112. Is it not at variance with all that is known in regard to the economy of nature, to suppose that the heat which radiates from the sun, save that infinitesimal quantity that falls upon the planetary bodies, subserves no immediate or ulterior purpose in

creation, but is dissipated and utterly lost in the infinitudes of space?

113. Does the heat, which radiates from a fixed star, traverse the space which intervenes between that star and the earth; or is it, in its course, intercepted by that resisting medium which is said to pervade all space?

114. As it is experimentally known that the heat which radiates from a body in a state of incandescence may be intercepted by presenting to that body a transparent resisting medium; if, therefore, all space is pervaded by a resisting medium, will the heat, which radiates from the sun, be obstructed in its passage through that medium, and finally brought to a state of rest?

115. If so, at what distance from the sun will the heat, which is projected from that body, and transmitted through that medium, be brought to a state of rest?

116. Is the heat which radiates from the sun projected to the outskirts of the solar system? And is it arrested there? And does it accumulate there? And does it suffer condensation, and is ponderable there? And as the sun moves onward in absolute space, is it collected into one mass in the solar track? And is that mass dragged forward in the solar path?

117. Is the sun the parent of the planetary system?

118. If the sun is the parent of the planetary system, what is that matter by which the worlds were made?

119. If the heat which radiates from the sun is matter, and the sun is the parent of the planetary system, is heat that matter by which the worlds were made?

120. If the solid matter of the solar mass is resolving into heat, shall the earth, if burnt up, be resolved into heat? If, therefore, all the ponderable matter of this world is resolvable into heat, is heat that matter by which this world was made?

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121. If the planets cease not to increase in density, which may be inferred from indications observable in the crust of the earth, and from the oblate spheroidal figure of the globe, the mass of each of the planets, consequent upon the *lateral*, as also vertical pressure, which the particles of a sphere in a state of condensation of necessity undergoes, will resolve itself into numerous concentric spheres, or shells of matter, all separated from each other just as the rings which encircle the planet Saturn are separated.

122. If the mass of each of the planets is disposed into numerous concentric spheres, or shells of matter, is the solar mass also so constituted?

123. If the solar mass is disposed into numerous concentric spheres, or shells of matter; and if from the surface of that mass, matter ceases not to be projected, then, as ages roll on, shall those spheres, or shells of matter, successively disappear; but between the disappearance of one sphere, and the incandescence of another, shall a long period of darkness intervene?

124. During the continuance of a solar day, is there projected from the sun, to the remote regions of the solar system, the matter of one of those concentric spheres of which we suppose the solar mass is constituted; and during the continuance of a solar day, is there accumulated, in the remote regions of the solar system, a mass of attenuated matter, but destined to become the solid fabric of a future world?

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125. If the tail of a comet is educed and elongated by matter which is projected from the sun, what, therefore, must be the intensity of that force which projected the nebulous atmosphere of the comet of

1680, one hundred and twelve millions of miles beyond the nucleus of that body?

126. If matter is projected from the sun to the remote regions of the solar system, and is arrested there, will the matter at rest be upheld because of the impact upon it of the matter in motion? but as the matter collected at the outskirts of the solar system increases in density, and, therefore, diminishes in magnitude, the impact upon it of the matter projected from the sun will be always the less, and, therefore, the matter in process of condensation will, because of this, approach nearer and nearer to the sun?

127. If matter is projected from the sun to the remote regions of the solar system, and impinges upon the planetary bodies, the planets are, therefore, acted upon by two forces—by gravity, which impels them in a direction towards the sun, and by the matter projected from that body, which impels them in an opposite direction. Are these two forces, at the mean distance of a planet from the sun, in a state of equilibrium?

128. If so, the mass and diameter of a planet being given, to find the position of that planet in the solar system.

It is possible that the masses of all the planetary

bodies may not yet be accurately determined, as it would appear that Encke's comet has recently led to a determination of a smaller mass for the planet Mercury.

129. Has the ocean of the planet Venus evaporated consequent upon its proximity to the sun? and because of this, is the apparent disc of that planet enlarged?

130. If the density of the planet Venus could be determined apart from the atmosphere which surrounds it, would it be found that the density of the solid mass of Venus is greater than that of the Earth?

131. If the densities of the planets could be respectively determined apart from the water and atmosphere which surround them, would it be found that the density of the solid mass of a planet is always the greater according to the proximity of that planet to the sun?

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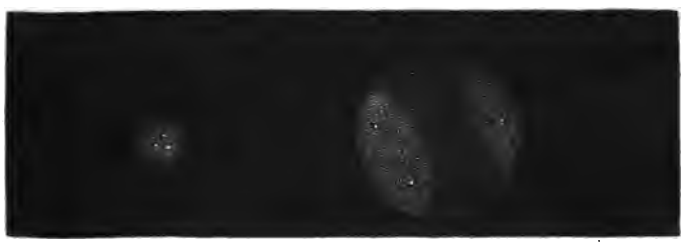
132. In place of a nebula, according to the nebular hypothesis, giving birth to a star, is it so, that every star gives birth to a nebula or cluster of stars?

133. Are the unresolved nebulæ or clusters of stars, *Figs.* 18, 19, 20, the products of the visible stars with which each is associated?

Fig. 18.

Fig. 19.

Fig. 20.

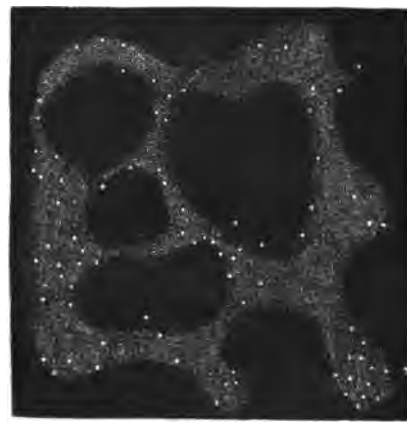


134. Is the reticulated unresolved nebula, *Fig.* 21, the product of the visible stars with which it is associated?

135. Sir John Herschel has noticed, in the London Philosophical Transactions for 1833, "that he has

FIG. 21.

RETICULATED NEBULA.



often seen, when the sky is quite clear, all the large stars above the seventh magnitude surrounded with photospheres of 2′ or 3′ or more in diameter, precisely resembling that about the finer specimens of nebulous stars." Do these photospheres consist of luminous points or stars, though yet unresolvable by our best telescopes, each photosphere being a portion of that firmament of stars to which, as we suppose, each star or system of stars is destined to give birth?

136. If the planets cease not to increase in density, will they at length become incandescent?

137. Do self-luminous stars within determinate distances repel each other? but beyond those distances, have they a tendency to gravitate toward

each other? And is it because of these antagonist forces, that stars are found associated together in clusters, and not concentrated into one self-luminous or incandescent mass?

138. In the remote past, has our sun given birth to numerous planetary bodies, which have become self-luminous, and which are now observable as nebulous matter in the distant regions of the solar system?

139. What is the zodiacal light? Is it analogous to those photospheres which have been observed by Sir John Herschel as surrounding the larger stars of our firmament; but which, though yet unresolvable by our best telescopes, is a portion of that firmament of stars to which the sun, as we suppose, is destined to give birth?

From late observations upon the zodiacal light, it would seem that the light is only upon one side of the sun, and if seen from a distant point of view in space, would it, with the sun, present somewhat the appearance of the nebulæ, *Fig. 22*?

140. Shall the Earth, if burned up, and the planets in their turn, become each the parent of a planetary system; and thus there shall be the creation of suns, and worlds, and systems in never-ending succession?

FIG. 22.

141. When a mass of matter has a motion of translation in space, and draws after it another mass that contains less matter than itself, will the mass which is dragged move with a greater velocity than the mass which drags it? In what circumstances will the momentum of the first body be communicated to the second, and, therefore, the velocity of the second body will be greater than that of the first?

142. If the sun, the mass of which is 354,936 times greater than that of the Earth, has a motion of translation in space, and draws after it the whole of the planetary bodies, will the velocities of the planets be greater than that of the sun?

143. If so, is it this *tractile force* which the sun in his course imparts to the planetary bodies, that gives motion to those bodies, and not the primal projectile

impulse which has been assumed by astronomers? And if so, what extent of orbit would the sun require to describe in absolute space, and with what velocity would the sun require to move in that orbit, that so the *tractile* force *which thus becomes tangential* would cause those bodies to describe their respective orbits about the sun?

144. If the sun in his motion of translation in space imparts to each of the planetary bodies a *tractile* impulse, is this impulse imparted and expended with every revolution of a planet about the sun?

145. How is it that the sun's motion of translation in space at the estimated rate of four hundred and twenty-two thousand miles in twenty-four hours; also the *tractile force* which the sun in his course imparts to the planetary bodies; and also the repulsive force by which the nebulous atmosphere of a comet is impelled behind it, as it approaches the sun, but in advance of it as it recedes from that body, are all ignored by astronomers in their rationale of the solar system—whereas in their explication of that system—a primal projectile impulse, an unresisting medium, and the sun's immobility in space, are hypothetically assumed by them?

146. If the corpuscular theory of light be the

sound one, and all space is pervaded by a resisting medium, is it so, that the velocity of light is not uniform—is the light, as it is projected from a fixed star, of greater velocity than the light of that star as it nears the earth?

147. How is it, that when the occultation of a star takes place behind the limb of the moon, the projection of that star upon the moon's disc is sometimes apparent? Is it because the velocity of the light which is reflected from the moon, is greater than that of the star which is about to be eclipsed, and therefore the star is apparent upon the moon's disc after the limb of the moon is intercepted between that star and the earth?

A

TRACT OF MISCELLANIES.

ON A GEOGRAPHICAL NOMENCLATURE.

148. DESIDERATUM.—The invention and adoption of a New Geographical Nomenclature, of such a nature that the name of every place shall include the longitude and latitude of that place, and thus the name of a place being given, we shall be able to point out the position of that place upon the map; also the longitude and latitude of a place being known, we shall be able to give its name. In addition to this an adjunct would be required to indicate the thing signified—whether a town, a lake, a mountain, an island, and so forth. With a view to this, let the consonants of the alphabet be employed—one of the consonants to indicate that the thing signified is a town, another consonant to indicate that the thing signified is a lake, and so on; and let the vowels be employed to represent magnitudes. Thus the first vowel of the alphabet an-

nexed to the consonant that represented a town, would indicate a town of the first magnitude, the second vowel annexed would represent a town of the second magnitude, and so on down to the last vowel of the alphabet, which would represent a hamlet. So also with mountains, and lakes, and rivers, and seas, and islands, &c., &c.—each having a consonant to represent it, and the vowel annexed to indicate the magnitude of each. The names of oceans, lakes, countries, and islands would require to be indicated by the longitude and latitude of the central parts of these respectively, and that of a river by the longitude and latitude of the mouth of the river. Thus a Geographical Nomenclature so constructed would, analogous to the chemical nomenclature of the neutral salts, enable us to accomplish in a few hours what cannot now be achieved in a lifetime.

ON THE ACQUISITION OF LANGUAGES.

149. Montaigne, when he had passed the years of infancy, was put under the tuition of a Latin master; and when six years of age, it is said that, without Dictionary, Grammar, or any preparatory task-work, he could speak pure Latin. How very

few are able to speak pure Latin under the present system of tuition, though engaged with it, for several hours daily, during the whole, or nearly the whole, of their educational course!

Some years ago I put to the test Montaigne's method, or one somewhat analogous to it, of acquiring the Latin language. Those young gentlemen whose studies were directed with a view to a mercantile profession or to a civil appointment, or with a view to enter the army or navy, were placed under the tuition of a Latin master, who required of them no preparatory task-work before they assembled in their respective classes, but proceeded at once to the work of translation—the master being to them the Dictionary and Grammar. The business of the class consisted at the outset of a very simple exercise—the master translating a sentence of an elementary work in Latin, and the young gentlemen rehearsing it. When the class had acquired a considerable vocabulary of Latin words, these elementary exercises were discontinued. The young gentlemen now proceeded to the work of translation themselves, the master guiding them when necessary in the construction of sentences, and still being to them the Dictionary and Grammar. The result, after three years' practice, was so very striking and

satisfactory, as to warrant me in saying, that, with one hour daily during the whole of an educational course, at this work of translation, young gentlemen, without any further tuition, might proceed at once to construct the most involved sentences, and translate the most difficult passages of any Latin author. What is true in respect to the acquisition of Latin by this method must also be true in respect to the acquisition of any other language by the same method.

ON SCHOOLS OF NATURAL AND SOCIAL SCIENCE.

150. Would not a great boon be accorded to the nation were the State, by the extension and endowment of Schools of Natural Science, to pervade the public mind with that wholesome, and might it not be said divine, knowledge, which is derived from the study of that great Book that has God for its Author—the Book of Nature?

We cannot conceive that any sectarian opposition would be offered to a Government Scheme of Education, the object of which was to impart to all classes, and to individuals of all ages, that knowledge which is derived from the study of Natural and Social Science, and which is so intimately con-

nected with the progress of society and the realities of life—the courses of instruction in Natural Science to be such as are taught in our Universities, but cast in a more popular form. That the people of Scotland are fully prepared for the acceptance of such a scheme of education, we would infer from the attendance of artisans upon those lectures on Natural Science that are delivered in our mechanics' schools; also from the presence of the middle classes in the hall of a provincial town, when a course of lectures is there delivered on any of the Physical Sciences; and also from the attendance both of the upper and middle classes in the sections of the Scientific Association during their sittings in our larger towns.

SUGGESTIONS.

Let the following courses of Lectures be instituted:—

1. Mechanical Philosophy.
2. Chemistry.
3. Geology.
4. Astronomy.
5. Electricity.
6. Natural History.
7. Agriculture, Horticulture, and Floriculture.
8. Social Science.

There would be thus a series of lectures—one of

which delivered annually, would extend the curriculum to eight years. It would be well that, at the commencement of the second curriculum, the Lectures on Mechanical Philosophy or of any of the other courses should not be delivered by the individual who had lectured in the same town or district eight years before on the same subject. For, just as one might not be disposed to read the same book twice on any one subject, but might be disposed to read two books on the same subject by two different authors, so one might not be disposed to attend the same course of lectures twice when delivered by the same lecturer; but might be disposed to attend two courses of lectures upon the same subject when delivered at long intervals by two different lecturers. In order to this, the lecturers would require to itinerate. We do think, by this arrangement and the changes which would take place in the course of eight years in the various sciences—arising from new discoveries having been made, and new views adopted in those sciences—a goodly attendance upon those lectures in the smaller towns might be perennially maintained.

Let the Lectureships be endowed by the State, and in order to supplement the endowment, let a small fee be taken.

ON THE FRENCH LAW OF INHERITANCE.

151. In all the old communities of Europe the cry of suffering humanity has been heard but not responded to—thousands are inadequately fed and others famishing. Assuredly in the dark and squalid dens at the bottom of the social fabric the realities of wretchedness are there—a wretchedness, constituted as society now is, hopelessly and helplessly endured. We have, however, no sympathy with the sentiment which for the first time was promulgated, and that too in Parliament, by a member of the House of Commons, to the effect that it was grossly deluding the people to tell them that any thing but misery was the lot of the great mass of mankind; nor with that of M. Thiers, when he states that "in the general plan of things, misery is the inevitable condition of the human race;" nor with Sir Robert Peel, when he says the sufferings of the poor are irremediable. All this may be true with society constituted as it now is—in which there are more people than there is food for. Where there is an excess of population there must be destitution somewhere, and the tendency of the Poor Laws for the relief of indigence is just to haul in to the gulf of destitution as many as they drag

out of it. What is wanted is a state of society in which there shall be a right adjustment of the population between food and numbers. According to the last census of Scotland, 48 per cent. of the adult population between the ages of twenty and forty were unmarried, and still in Scotland there are more people than there is food for. Is it so, that in the old communities of Europe not more than one third of the adult population can marry with impunity, and as the average duration of human life extends, fewer marriages will be required?

Were the French Law of Inheritance somewhat modified, it would go far to solve the problem of a right adjustment between food and numbers. As the law stands at present, there is no limit to the subdivision of landed property. What is required is a limit, and that limit is palpably obvious. When once a property under the present process of subdivision is so reduced as shall just afford to an average family an adequate supply of cereal, vegetable and animal food, the State should then interpose, and by a strict deed of entail the further subdivision of the property should forthwith cease; and while the members of the family to whom the property belongs should equally participate in the produce of it, they should be dispossessed

by the deed of entail of the power either to mortgage or dispose of it—the last surviving member of the family to inherit the whole, and at his decease the property to descend to the family nearest akin. With the French Law of Inheritance thus modified, and with the growing intelligence of a people consequent upon a sound secular education in connection with religious instruction—teaching what is due to God and due to mankind—society might be able to work out for itself the great desideratum in our social condition, namely, a right adjustment between food and numbers. In such a state of society it would be better defined than it now is when a man *might* marry and when he *ought* not.

With an increase in the number of entailed properties, more of the agricultural produce would be consumed by the rural population, and consequently, less to dispose of to the inhabitants of towns. Towns as they now are would, therefore, gradually decline, and the country, with the increase of entailed properties, would ultimately become as one great rural city. In the remote past, human beings congregated into towns surrounded with walls for self-preservation. Latterly towns have been built with a view to the convenience of carrying on the various trades and professions; but now that we have rail-

ways, steamboats, omnibuses, the electric telegraph and the penny postage, there is not the same necessity as formerly for a condensation of the population into towns for commercial purposes. As one of these entailed properties would yield to an average family not more than the first necessaries of life, the members of a family not engaged in agriculture would require to betake themselves to other trades and professions, in order to procure for themselves the second necessaries. These trades and professions would thus revert to what was their original design, namely, to procure for man all that man requires beyond that of mere aliment. With the growing intelligence of the people a question would arise, whether or not it would be more advantageous for those with entailed properties to cultivate their own respective allotments themselves; or to incorporate a given number of those entailed properties into one farm, to be cultivated for the benefit of the families to whom they belonged. By this arrangement the members of a family would be free to betake themselves to other trades and professions.

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152. What could man do if he would? Could he morally exist without doing violence to his natural tendencies? Could he exterminate, if he would, all

hereditary diseases? Could he physically improve his own species as surely as he improves some of the species of inferior animals? And by the amelioration of his social condition, and by sanitary observances, could he add another and another decade to the average life of mankind?

153. Desideratum.—A treatise on the sinfulness of neglecting sanitary observances, and of perpetuating by marriage hereditary diseases.

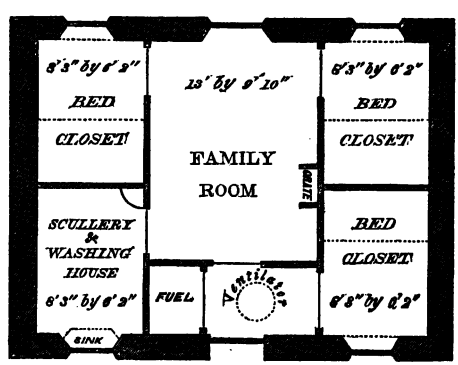
154. Is it so, that the Creator does not directly accord health to human beings, but bestows upon them capabilities by which to promote and preserve it; leaving it mainly to man himself the alternative, whether he shall or shall not enjoy health?

155. Desideratum.—With a view to the extension of the average duration of human life, let no one be allowed to build a dwelling-house until the site, the sewerage, the ventilation, and the plan of the house be approved of by a Sanitary Board.*

* If so, a lower grade of dwelling-house than the following ought not to be sanctioned by a Sanitary Board. The great desideratum in the improvement of our cottages, is an increase in the number of sleeping apartments. The smallness of those apartments, however, in the subjoined plan, requires that they shall be thoroughly ventilated. And this may be done by a partial opening of the windows, but the changeableness and the severity of our climate forbids it. The air which we exspire

156. In the construction or upbuilding of every human fabric, would it not be well for man to assume as his standard of taste, that which is observable in the organic structures of the Great Architect—all of which, with rare exceptions, present externally symmetrical forms—have the perfection of fitness impressed upon every part, and with the exception of colour, have mainly the absence of all ornament?

from the lungs, ought not to be inspired a second time. At a temperature of 96° or thereabouts, it rises to the ceiling of an apartment, where some way of escape for it should be provided. It is therefore proposed that the space between the upper part of the door of each apartment and the ceiling, should be left open, and fresh air admitted through the ventilator in the lobby from openings in the roof of the cottage, which in its descent would pass through air of a higher temperature, and coming in contact with the walls and floor and furniture, would reach the sleeping apartments divested of its superfluous moisture, and with its temperature considerably modified.



157. Desideratum.—A Treatise on the Cure of Incipient Diseases. Is it so, that what palliates a disease in its advanced stage, will cure it in its incipient state? And is it so that there are numerous specifics for diseases in their incipient state, but few specifics, if any, for diseases in their advanced stage?*

158. It is well known that gases and vapours possess the power of miscibility with each other so remarkably, that when brought together they speedily constitute themselves into one homogeneous mass. It is therefore evident, that extraneous gases or vapours, when they enter the atmosphere, must be rapidly diffused over the districts from which they emanate. Now if atmospheric diseases arise, as is supposed, from a mephitic gas or vapour existing in the atmosphere, how comes it that an atmosphere so impregnated with morbid matter does not

* I have found that the first touch of sore throat, and the first tendency to cough, may be suppressed simply by the use of an emollient, but that they will not be suppressed by such a simple remedy if allowed to go on for several days, or even hours; and also that the first touch of tooth-ache may be checked by having recourse to any one of those numerous specifics which are advertised as a cure for tooth-ache in its advanced stage; also I find that rheumatism and sciatica upon their first symptom, may be suppressed by the immediate application of a liniment, but which will fail as a remedy if allowed to go on for several hours.

at once make an invasion upon all the families of the district over which it extends, but capriciously, as it appears to us, to attack isolated families, while others, who seem equally exposed to the contagion—who live in the same district, or in the immediate neighbourhood, escape?

159. Do isolated swarms of insects exist in the atmosphere analogous to the animalcules that exist in water, but which are so minute as not sensibly to impair the transparency of the atmosphere? * If so, are those insects, during the process of respiration, largely inspired into the lungs, insomuch that a morbid taint is imparted to the blood? and is it from this cause that fevers and those other diseases which are supposed to be atmospheric, have their origin—one species of insect as it exists in the atmosphere generating one kind of fever—other species generating fevers of a different kind, and so on with other diseases which are also supposed to be atmospheric?

160. If animalcules exist in the atmosphere as well as in water, then as putrid water is the *habitat* of the one class, may not a putrid vapour existing in the atmosphere be the *habitat* of the other; and is

* Ehrenberg has discovered in bog-iron ore, fossil animalcules so very minute, that a cubic inch of the ore contains two millions of millions of those animalcules.

it so, that each class of insects derives its nutriment from the putrescence which surrounds it?

161. Do animalcules which exist in the atmosphere derive their nutriment from the vapours which arise from vegetable or animal matters in a state of putrefaction or decomposition? and if so, were all vegetable and animal matters buried beneath the surface of the ground the instant the vegetative principle of the one, and the vital principle of the other had departed from them, or before decomposition had begun to take place, would atmospheric diseases cease to prevail?

162. How is it that swarms of insects are observed to maintain the same position in the atmosphere, without any perceptible movement either to the one side or to the other? Is it from this cause—In the atmosphere where the insects swarm, there is an escape of vapour from beneath, arising from vegetable or animal matter in a state of decomposition, from which vapour those insects derive their nutriment? Upon one occasion we observed a swarm of insects hovering above a piece of cloth which had been steeped in fatty matter; the insects maintained their position above the cloth for such a length of time, that we could not avoid the inference that the posi-

tion of the insects at that place was in connection with the cloth beneath.

We therefore removed the cloth to some distance, and immediately the swarm of insects changed their place, and again t oo up their position as before above the cloth. This we repeated several times, and with the same result.

163. There are certain classes of artisans, such as flax-dressers, millers, hewers of stone, and others, who, it is said, are particularly subject to chest-complaints, arising, as it is supposed, from the gritty, dusty or filamentous particles which they draw into their lungs while engaged in their respective occupations. Thus the flax-dresser inspires the filamentous particles which float so abundantly in the atmosphere that surrounds him. The stone-hewer inhales the gritty particles which are driven off into the atmosphere while operating upon calcareous or siliceous blocks of stone; and at one time, too, the flint-grinders, who before the process of grinding under water was adopted, were enveloped during their operations in an atmosphere charged with minute siliceous particles. All those classes were particularly subject to chest-complaints. Now, how is it that the people of this country are so subject to pulmonary diseases ?

Is it, neither because of the changeableness of our climate, nor because of the cold and damp of our northern region, that those diseases are induced, but mainly because of the quantities of dust which we inhale into our lungs during the process of respiration—that dust being largely diffused in the atmosphere of our dwelling-houses, and chiefly derived from our open fireplaces, and from the quantities of woollen stuffs which are so much used by us, both as articles of furniture as well as of clothing? It sometimes happens that the dust which floats in the atmosphere of a room is not visible until a beam of sunshine darts across the apartment; and it also sometimes happens that the dust is not visible in the sunbeam. If, however, a slip of transparent glass be dipped in a solution of gum and suspended in the atmosphere of a room, it will be found that the glass, when microscopically examined, is covered with an infinitude of minute particles of dust; which indicates that during the process of respiration, particles of dust may be largely inspired into the lungs while the atmosphere seems perfectly pure and transparent?

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164. Might not one great nation give liberty and peace to all the nations of the world—would not

the people of every nation co-operate with that great nation, and consummate for themselves what to them is so very precious?

165. In the present stage of the world's progress, what is the best form of Government? Is it that of a monarchy in which the Sovereign reigns but does not govern?

---

166. Desideratum.—A Map of the Heavens, in which the constellations shall consist of a series of triangles—the angular points of those triangles being stars of the first or second magnitude; and to each Observatory of the world let one of these constellations be allotted, to count the number of its stars, and to observe the changes which it undergoes.

167. In this age of achievement, to connect, by means of a chain or rope, the summit of Mont Blanc with its base, and by the aid of this connecting medium to guide in safety a balloon with passengers from the base of the mountain to the summit, and again from the summit of the mountain to the base. Desideratum.—The erection of an Observatory on the summit of Mont Blanc.

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